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# A different and safe method of split thickness skin graft fixation: Medical honey application

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ABSTRACT

Honey has been used for medicinal purposes since ancient times. Its antibacterial effects have been established during the past few decades. Still, modern medical practitioners hesitate to apply honey for local treatment of wounds. This may be because of the expected messiness of such local application. Hence, if honey is to be used for medicinal purposes, it has to meet certain criteria. The authors evaluated its use for the split thickness skin graft fixation because of its adhesive and other beneficial effects in 11 patients. No complications such as graft loss, infection, and graft rejection were seen. Based on these results, the authors advised honey as a new agent for split thickness skin graft fixation.

In recent years there has been a renewed interest in honey wound management. There are a range of regulated wound care products that contain honey available on the Drug Tariff. This article addresses key issues associated with the use of honey, outlining how it may be best used, in which methods of split thickness skin graft fixations it may be used, and what clinical outcomes may be anticipated. For this reason, 11 patients who underwent different diagnosis were included in this study. In all the patients same medical honey was used for the fixation of the skin graft. No graft loss was seen during both the first dressing and the last view of the grafted areas. As a result, it has been shown that honey is also a very effective agent for split thickness skin graft fixations. Because it is a natural agent, it can be easily used in all skin graft operation for the fixation of the split thickness skin grafts.



## 1. Introduction

Honey has been used for medicinal purposes since ancient times [1]. It was used topically in the Ayurvedic medicine of 2500 B.C., and the Egyptians, Greeks, and Romans used it as well [2]. Hippocrates prescribed honey for various indications, including the management of wounds and gastritis, and the wound-healing properties of honey were mentioned in the Qur'an and the Bible. After having played an important part in the traditional medicine for centuries, honey was subjected to laboratory and clinical investigations during the past few decades [3–5]. The most remarkable discovery was the antibacterial activity of honey that has been confirmed in numerous studies [4,11]. This antibacterial activity is related to four properties of honey. First, honey is a supersaturated sugar solution, and this results in a strong interaction between the sugar molecules and water molecules. This ''osmotic effect'' leaves very few water molecules for growth support of microorganisms. The rate of inhibition of growth depends on the species of bacteria and the concentration of honey [9]. Second, the pH of honey is between 3.2 and 4.5, and this acidity is low enough to inhibit the growth of most microorganisms [6,7]. Hydrogen peroxide produced by the glucose oxidase is the third and probably the most important antibacterial component, although some authors believe the nonperoxide activity to be more important. Lastly, several

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phytochemical factors for antibacterial activity have been identified in honey. When applied on the tissue defect areas, the osmotic effect and acidity of honey decrease on dilution in recipient fluids—more so because these fluids are well buffered. Contrary to this decrease, hydrogen peroxide activity increases 2.5–50.0 times on dilution. In this dosage, hydrogen peroxide is still antiseptic without damage to the tissues [8,12]. Likewise, most phytochemical factors withstand dilution in wound fluids. Overall, honey has a restraining influence on the growth of most bacteria, including some methicillin-resistant *Staphylococcus aureus* strains. This makes honey attractive for the prevention and treatment of infections in chronic wounds [8,10], as well as for the treatment of acute wounds. Unlike most conventional local chemotherapeutics, honey does not lead to the development of antibiotic-resistant bacteria, and it may be used continuously. Although there is obvious interest in the application of honey in wound treatment, medical practitioners hesitate to use it because the mode of application often is messy [13–18]. Hence, honey that is to be used for medicinal purposes has to meet certain criteria. As such, it has to be free of residual herbicides, pesticides, heavy metals, and radioactivity. It has to be sterilized to prevent secondary wound infection. Furthermore, glucose oxidase in honey has to be controlled during processing to maintain the potency for infection prevention without doing harm to the wound tissues. Besides these primary conditions, the application of honey should be easy [19–22]. Based on these requirements, fixation by using honey was developed by impregnation of a modern synthetic material with decontaminated and regulated honey (HoneySoft; MediProf, Moerkapelle, The Netherlands). We performed a split thickness skin graft fixation to assess the clinical applicability of this dressing and present the outcome here.

## 2. Materials and methods

Eleven patients were included in this study. Etiology of the tissue defects is shown in Table 1. There were 4 (36%) women and 7 (64%) men, with an average age of 41.6 years (range, 15–70 years). Most patients were treated as outpatients ($n = 9$), but two patients started treatment in a clinical setting and went on to continue therapy after discharge. Follow-up period was average 17 months (10–24 months). All wounds were opened on the fifth day of grafting. First observation was done on the fifth day. And next, dressing was done every other day with wet gauze. In all patients, the decontaminated and regulated honey (HoneySoft; MediProf, Moerkapelle, The Netherlands) was used for split skin grafts fixations. All the honey products were sterilized with the cobalt 60 gamma radiation [16]. Honey was applied on the defect areas drop by drop with a medicine dropper. Distance between the drops of honey was changed according to surgeon experience and size of the defect area. For example, it can be spaced 5–7 cm on the defect area which is 15 cm × 10 cm in size.

## 3. Results

All patients completed treatment assisted with honey application for fixation of the split thickness skin graft. During honey application for the fixation of split thickness skin graft, we observed that the decrease of edema and wound exudates from the recipient area. No allergic reactions occurred during this study. First wound dressing was opened on the fifth day of grafting in all patients. The first evaluating points in the grafted areas with honey application were for graft loss, infection, mobilization of grafts, and hematoma. No complications such as these were seen in any patients at any time of the operation. At the next dressing, topical application of

**Table 1 – Patients characteristics**

| Patients | Age (year), sex (M/F) | Etiology of the tissue defect | Adherent disease | Graft loss at first dressing | Graft loss at next | Extra information about the patient |
|---|---|---|---|---|---|---|
| 1 | 15, F | Trauma due to traffic accident | No | No | No | Type I Tibia fracture (OP) |
| 2 | 45, M | Trauma due to traffic accident | No | No | No | There was external fixation in his leg because of the tibial fracture (H) |
| 3 | 39, M | Trauma due to traffic accident | No | No | No | He has undergone Illizarov operation before we came. There was the devices related to Illizarov (H) |
| 4 | 70, M | Tissue defect after healled cellulitis | Diabetes mellitus | No | No | Blood sugar level was under controlled (OP) |
| 5 | 41, F | Neck burn | No | No | No | Cause of the fire (OP) |
| 6 | 28, F | Trauma due to traffic accident | No | No | No | No fracture was determined (OP) |
| 7 | 51, M | Tissue defect secondary to burn | No | No | No | Cause of the tandir (clay cooker) burn (OP) |
| 8 | 36, F | Trauma due to traffic accident | No | No | No | No fracture was determined (OP) |
| 9 | 26, M | Tissue defect secondary to leg burn | No | No | No | Cause of the hot water (OP) |
| 10 | 42, M | Trauma due to traffic accident | No | No | No | No fracture was determined (OP) |
| 11 | 65, M | Tissue defect after trauma | Diabetes mellitus | No | No | No fracture was determined (OP) |

M, male; F, female; OP, outpatient; H, hospitalized patient.

antimicrobial pomad nor systemic antibiotics were used. Even at the last follow-up, there was no graft loss, infection and other complications related to grafting in all patients. In all patients, decontaminated and regulated honey (HoneySoft; MediProf, Moerkapelle, The Netherlands) was used for fixation of split thickness skin graft.

## 4. Cases reports

### 4.1. *Case 1*

A 45-year-old man suffered a traffic incident 2 months previously. There had been a tissue defect in his right leg. He had undergone external fixation for his tibial fracture (Fig. 1a). A tissue defect was detected just near the external fixators device 6 cm × 5 cm in size. Tissue culture was taken from the open wound. In the result of the tissue culture, it was no pathogenic microorganism or contamination was present. Split thickness skin graft fixation assisted with medical honey application was performed on the patient (Fig. 1b). At follow-up (12 months after operation) (Fig. 1c), no complication related to graft and honey application for fixation of split thickness skin graft was seen.

### 4.2. *Case 2*

A 39-year-old man suffered a traffic incident 5 months ago. There had been a tissue defect in his left leg. He had undergone external fixation for his tibial fracture (Fig. 2a). A tissue defect was detected just near the external fixation device 12 cm × 3 cm in size. Tissue culture was taken from the open wound. In the result of the tissue culture, it was reported that no pathogen microorganism reproduced and no contamination took place. Split thickness skin graft assisted with medical honey application for graft fixation (Fig. 2b) was performed on the patient. At follow-up (10 months after operation) (Fig. 2c), no complication related to graft and honey application for fixation of split thickness skin graft was seen.

### 4.3. *Case 3*

A 70-year-old man was admitted to our clinic because of a diabetic wound in his left foot. It was detected that he suffered a traffic incident 2 months previously. A tissuedefect was detected in his foot (Fig. 3a). A tissue defect measuring 11 cm × 6 cm in size was detected at the lateral side of his foot. Blood sugar was regulated when he came to us. Tissue culture was taken from the open wound. In the result of the tissue culture, it was reported that no pathogenic microorganism or contamination was present. Split thickness skin graft assisted with medical honey application for graft fixation (Fig. 3b) was performed on the patient. At follow-up (2 years after operation) (Fig. 3c), no complication related to graft and honey application for fixation of split thickness skin graft was seen.

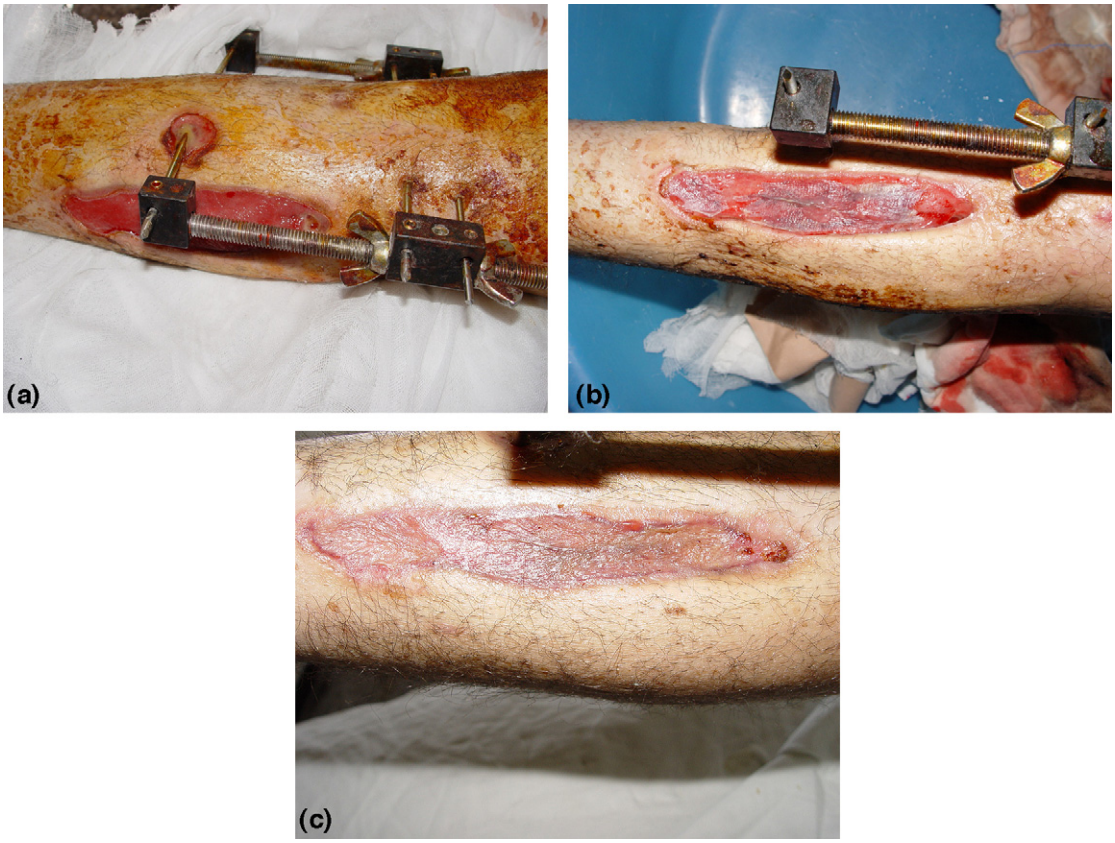


**Fig. 1**

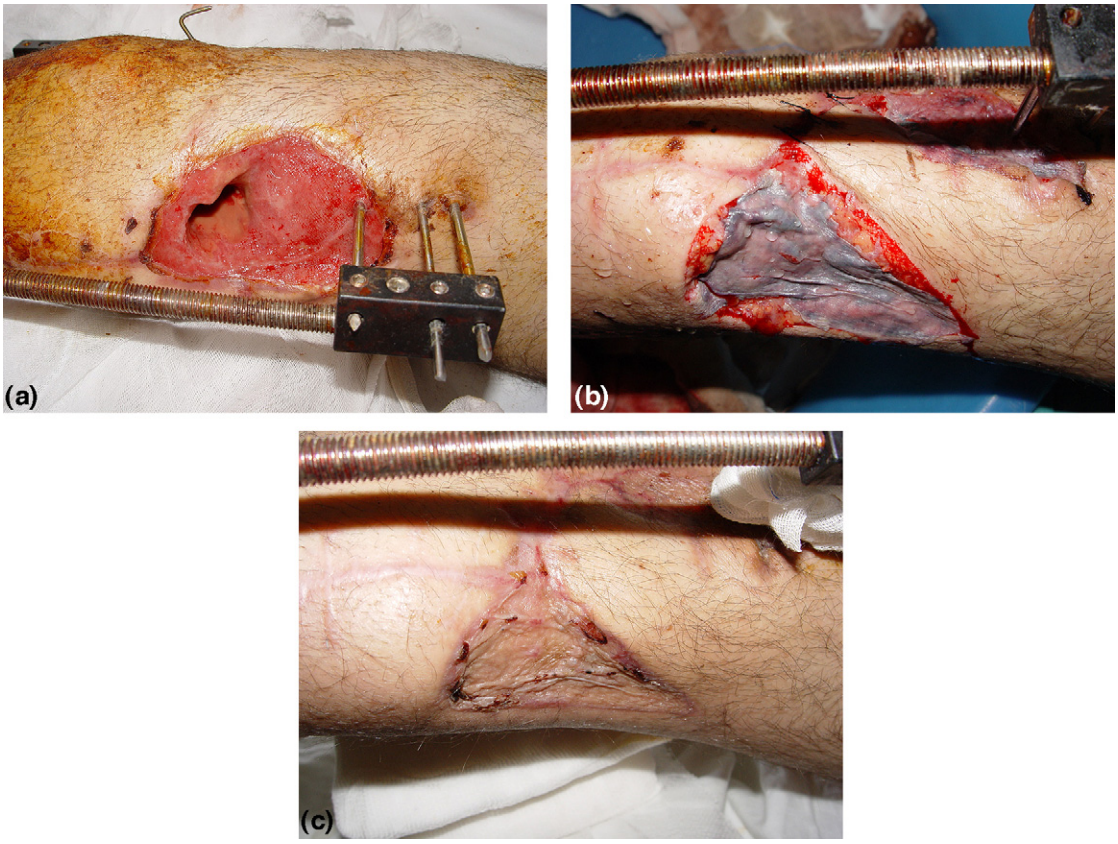


Fig. 2


Fig. 3

## 5. Discussion

The success of skin grafting, or ''take,'' depends on the ability of the graft to receive nutrients and, subsequently, the vascular in-growth from the recipient bed. Skin graft revascularization or ''take'' occurs in three phases. The first phase involves a process of serum inhibition and lasts for 24–48 h. Initially, a fibrin layer forms when the graft is placed on the recipient bed binding the graft to the bed. Absorption of nutrients into the graft occurs by capillary action from the recipient bed. The second phase is an inosculatory phase in which recipient and donor end capillaries are aligned. In the third phase the graft is revascularized through these ''kissing'' capillaries. Because the full-thickness skin graft is thicker, survival of the graft is more precarious, demanding a well-vascularized bed. The most common cause of graft failure is blood or serous fluid collection beneath the graft, raising the graft from the bed and preventing revascularization. Movement of the graft on the bed interrupts revascularization, and immobilization techniques include the use of bolster dressings on the face or trunk or splinting of the extremities.

The second most common cause of graft failure is infection. The risk of infection can be minimized by careful preparation of the recipient site and early inspection of grafts applied to contaminated beds. Wounds that contain more than 105 organisms per gram of tissues will not support a skin graft [11,12]. In addition, an infection at the graft donor site can convert a partial-thickness dermal loss into a full-thickness skin loss [22–25].

There are many methods and products in the literature on skin graft fixation. Some of them include applying cyanoacrylate [26], fibrin glue [27], surgical drape [28], etc. Particularly, most of the cyanoacrylate and other fibrin or tissue glues are synthetic materials, and they can cause inflammatory responses in an open wound, and, we do not know about the long term side effects of these synthetic elements in future. Many other methods on skin grafts securing have also been mentioned. Some of them are complex, and others are not. Some of them are useful while others are not. Medical honey has been used in wound management, treatment of the pressure ulcers, and infected leg ulcers, and it has been shown to be a very effective agent. We used the medical honey first on skin graft fixation because of its advantages such as: its antibacterial activity (due to contained inhibin factor), its adhesive properties, and its anti-inflammatory effect (it can reduced the severity of pain) [29]. Especially, we observed that it has strong adhesive properties for skin graft fixation. Most important factor in this study is that our fixation material called medical honey is a natural material, not synthetic. For this reason, we can advise the application of the medical honey for the fixation of split thickness skin graft.

## 6. In conclusion

Medical honey has been found to be a very effective agent in skin graft fixation because of its properties. This agent has prevented negative factors of skin graft loss such as infection and mobilization. There is no need of skin or graft suturation. Major advantages of this procedure are that it ise time saving, easy in application, and cheap. But, it should be used sterile.

## REFERENCES


[1] Majno G. The healing hand. Man and wound in the ancient world. Harvard University Press: Cambridge, MA; 1975. p. 571.
[2] Ransome HM. The sacred bee in ancient times and folklore. London: Allen & Unwin; 1937. p. 308.
[3] Gunther RT. The Greek herbal dioscorides. New York: Hafner; 1959 [Goodyear J, trans.].
[4] Zumla A, Lulat A. Honey—a remedy rediscovered. J R Soc Med 1989;82:384–5.
[5] Allen KL, Molan PC, Reid GM. A survey of the antibacterial activity of some New Zealand honeys. J Pharm Pharmacol 1991;43:817–22.
[6] Obaseiki-Ebor EE, Afonya TCA. Preliminary report on the antimicrobial activity of honey distillate. J Pharm Pharmacol 1983;35:748–9.
[7] Efem SEE. Clinical observations on the wound healing properties of honey. Br J Surg 1988;75:679–81.
[8] Wahdan HAL. Causes of the antimicrobial activity of honey. Infection 1998;26:26–31.
[9] Molan PC. The role of honey in the management of wounds. J Wound Care 1999;8:415–8.
[10] Cooper R, Molan PC. The use of honey as a antiseptic in managing *Pseudomonas* infection. J Wound Care 1999;8: 161–4.
[11] Efem SEE, Udoh KT, Iwara CI. The antimicrobial spectrum of honey and its clinical significance. Infection 1992;20: 227–9.
[12] Postmes T, Boogaard AE, van den Hazen M. Honey for wounds, ulcers, and skin graft preservation. Lancet 1993;341:756–7.
[13] Bergam A, Yanai J, Weis J, et al. Acceleration of wound healing by topical application of honey: an animal model. Am J Surg 1983;145:374–6.
[14] Postmes T, Bosch MMC, Dutrieux R, et al. Speeding up the healing of burns with honey. An experimental study with histological assessment of wound biopsies. In: Mizrahi A, Lensky Y, editors. Bee products: properties, applications and apiotherapy. New York: Plenum Press; 1997. p. 27–37.
[15] Subrahmanyam M, Archan M, Pawar SG. Antibacterial activity of honey on bacteria isolated from wounds. Ann Burns Fire Dist 2001;14:22–4.
[16] Postmes T, van den Boogaard A, Hazen M. The sterilization of honey with cobalt 60 gamma radiation: a study of honey spiked with spores of *Clostridium botulinum* and *Bacillus subtili*. Experientia 1995;51:986–9.
[17] Molan PC, Allen KL. The effect of gamma-irradiation on the antibacterial activity of honey. J Pharm Pharmacol 1996;48:1206–9.
[18] Molan PC. Honey as an anti microbial agent. In: Mizrahi A, Lensky Y, editors. Bee products. New York: Plenum Press; 1996. p. 27–37.
[19] Bogdanov S. Non-peroxide antimicrobial activity of honey. In: Mizrahi A, Lensky Y, editors. Bee products. New York: Plenum Press; 1996. p. 39–47.
[20] Greenwood D. Sixty years on: antimicrobial drug resistance comes of age. Lancet 1995;346(suppl 1):S1.
[21] Tovey FI. Honey and sugar as a dressing for wounds and ulcers. Trop Doct 2000;30:1 [Editorial].

[22] Snowdon JA, Cliver DO. Micro-organisms in honey. Int J Food Microbiol 1996;31:1–26.
[23] Birch J, Branemark PI. The vascularization of a free full thickness skin graft: a vital microscopic study. Scand J Plast Surg 1969;3:1.
[24] Converse JM, Rapaport FT. The vascularization of skin autografts and homografts: an experimental study in man. Ann Surg 1956;143:306.
[25] Haller JA, Billingham RE. Studies of the origin of vasculature in free skin grafts. Ann Surg 1967;166:896.
[26] Kulicki M, Noszczyk W, Wichrzycka E, Szretter-Szmid M, Mijalska K. Cyanoacrylate tissue adhesives of own production. Mater Med Pol 1973;5(1): 34–40.
[27] Milanov NO, Adamian RT, Shekhter AB, Istranov AL, Eiubov IuSh. Use of fibrin glue for covering microsurgical autotransplants with free split skin *Khirurgiia* (Mosk) 2004;(12):4–9.
[28] Yenidunya MO, Ozdengil E, Emsen IM. Split-thickness skin graft fixation with surgical drape. Plast Reconstr Surg 2000;106(6):1429–30.
[29] Dunford C. The use of honey-derived dressing to promote effective wound management. Prof Nurse 2005;20(8): 35–8.